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METHOD OF MANUFACTURING LIQUID CRYSTAL DISPLAY DEVICE AND ARRAY SUBSTRATE AS WELL AS LIQUID CRYSTAL DISPLAY DEVICE

[Abstract]

PROBLEM TO BE SOLVED: To curtail the number of stages when the conventional spherical spacer spraying system is replaced with a columnar spacer system formed by a photolithography system.

SOLUTION: The constitution of forming planarization films on switching active elements 3 of a array substrate 11a and forming pixel electrodes 8 on these planarization films includes a process step of forming a photosensitive resin 5 on the array substrate 11a and a process step of subjecting the

photosensitive resin 5 to exposure and development by a photomask 20 having patterns 20a for column spacers of total transmission, patterns 20c for contact holes to be formed in order to conduce the pixel electrodes 8 for light shielding and the switching active elements 3 and patterns 20b for the panel display regions of halftones exclusive of the columnar spacers 5b and the contact holes 7 in forming the planarization films. As a result, the columnar spacers 5b of a prescribed height and the contact holes 7 are integrally formed on the array substrate 11a by one time of the exposure and development.

[Claim(s)]

[Claim 1] A manufacturing method of a liquid crystal display apparatus comprising, a process for forming an array having a pixel electrode and a switching active element for driving said pixel electrode,

a process for forming a color filter substrate having an opposing electrode of said pixel electrode, a process for forming a cylinder-shaped spacer on said array substrate, and a process for sealing liquid crystal into a gap between said color filter substrate and said array substrate, wherein a flattening layer is formed on said switching active element of said array substrate, and said pixel electrode is formed on the flattening layer pixel, is characterized in that said method includes a process for forming a photo-sensitive resin on said array substrate, when forming said flattening layer, and a process for exposing said photo-sensitive resin to a light, and developing by using a photo-mask having a pattern for a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode, and a pattern for a panel display region except said cylinder-shaped spacer and said contact hole with each pattern having different transmissivity.

[Claim 2] A manufacturing method of a liquid crystal display apparatus,

comprising, a process for forming a color filter on-array substrate having a pixel electrode and a switching active element for driving said pixel electrode, a process for forming an opposing substrate having an opposing electrode of said pixel electrode, a process for forming a cylinder-shaped spacer on said color filter on-array substrate, and a process for sealing liquid crystal into a gap between said color filter on-array substrate and said opposing substrate, wherein a flattening layer including a coloring layer is formed on said switching active element of said color filter on-array substrate, and said pixel electrode is formed on the flattening layer pixel, is characterized in that said method includes a process for forming a photo-sensitive resin on said array substrate, when forming said flattening layer, and a process for exposing said photo-sensitive resin to a light, and developing by using a photo-mask having a pattern for a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode, and a pattern for a panel display region except said cylinder-shaped spacer and said contact hole with each pattern having different transmissivity.

[Claim 3] An array substrate is characterized in that it includes a color filter on-array substrate having a pixel electrode and a switching active

element for driving said pixel electrode, a flattening layer is formed on said switching active element, said pixel electrode is formed on a surface of said flattening layer, and a cylinder-shaped spacer for forming a cell gap is formed integrally with said flattening layer.

[Claim 4] An array substrate is characterized in that it includes a pixel electrode and a switching active element for driving said pixel electrode, a flattening layer having a coloring layer is formed on said switching active element, a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode is electrically formed on said flattening layer, and a cylinder-shaped spacer for forming a cell gap is formed integrally with said flattening layer.

[Claim 5] The LCD apparatus wherein a color filter substrate having the array substrate as set forth in the claim 3, and an opposing electrode of the pixel electrode.

[Claim 6] The LCD apparatus comprising an array substrate as set forth in the claim 4, and an opposing substrate having an opposing electrode of the pixel electrode.

[Title of the Invention]

METHOD OF MANUFACTURING LIQUID CRYSTAL DISPLAY DEVICE AND ARRAY SUBSTRATE AS WELL AS LIQUID CRYSTAL DISPLAY DEVICE

[Detailed Description of the Invention]

[Field of the Invention]

The object of the present invention is to improve the characteristics of LCD apparatus, display quality, and an yield and it is related to a manufacturing method of a LCD apparatus of which a cylinder-shaped spacer is formed on a surface of a substrate, an array substrate, and a LCD apparatus.

[Description of the Prior Art]

In FIG. 6, an example of a structure of a schematic cross-section of LCD apparatus of TFT type(below, it is called as [liquid crystal]).

This liquid crystal panel of TFT type 31d is composed of an array substrate 11d and a color filter substrate 11d.

A substrate 1d is composed of a color filter comprisa glass substrate 2a, a shading layer 4 formed on it, a coloring layer of RGB 6R, 6G, and 6B, and a transparent electrode 10.

The array substrate 11d is composed of a switching active element 3 on which a signal line and a scan line are formed on the glass substrate 2b, and a flattening layer 5 is composed of a switching active element 3 and a pixel electrode which conducts electrically by the switching active element 3 and a contact hole 7.

The orientation layers 9a, 9b are formed on the opposing surfaces of a substrate 1d, and an array substrate 11d, respectively. And liquid crystal is filled into a gap into which a cylinder-shaped spacer of the substrates 1d, 11d, is arranged, and a periphery is adhered with a seal member 13. According to the purpose of an liquid crystal panel 31d, a polarized plate can be bonded on an inner surface of the panel.

Further, FIG. 7 shows one example of a TFT liquid crystal panel of a general color filter on-array type.

The substrate 11c is composed of a switching active element 3 on which a signal line and a scan line are formed on the glass substrate 2b, a coloring layer 6R, 6G, 6B formed on it, a flattening layer 5 formed on it, and a pixel electrode 8 which conducts electrically by the switching active element 3 and a contact hole 7.

On the other hand, the array substrate 1c is composed of a

transparent electrode 10 formed on the glass substrate 2a.

The orientation layers 9a, 9b are formed on the opposing surfaces of a substrate 1c, and an on-array substrate 11d, respectively. And liquid crystal 14 is filled into a gap into which a cylinder-shaped spacer 15 of the substrates 1c, 11c, is arranged, and a periphery is adhered with a seal member 13. According to the purpose of an liquid crystal panel 31d, a polarized plate can be bonded on an inner surface of the panel.

Such a conventional TFT liquid crystal panel 31d, 31c has a problem as follows.

Firstly, the gap level between the array substrate and the color filter substrate is a major factor for determining display quality. That is, in case that non-uniformity of a gap exists on a surface of the panel, smears are generated on a display surface of the panel. In case that a panel gap deviates from a design value, there is a problem that a panel display such as a contrast and so on is deteriorated.

Secondly, in case that a white and black display is realized by applying a voltage to a panel through a ball-shaped spacer 15 positioned between a shading layer 4 of a pixel among a ball-shaped spacer 15 inserted the array substrate and the color filter substrate. Since a light leakage is

generated by a ball-shaped spacer 15, a white and black display can not be recognized easily, and a contrast is deteriorated because of a comparison of a black display against a white display.

Thirdly, in case of forming a panel as described above, distribution of a ball-shaped spacer 15 is performed by dry or wet method in order to adhere ball-shaped spacer 15 on a substrate, but when distributing this spacer, a point defect portion is created due to hardening of a ball-shaped spacer 15 or introduction of other substances. That is, this point defect portion affects the yield rate of a panel process.

Because of above-mentioned reasons, recently, a method for forming a cylinder-shaped spacer on a substrate in advance is being suggested instead of a ball-shaped spacer 15 formed by a prior distribution method.

[Problem(s) to be Solved by the Invention]

But, in case that a cylinder-shaped spacer method formed by a photo-lithography method is used instead of a conventional ball-shaped spacer distribution method, the cost will increase according to the method.

That is, in a conventional ball-shaped spacer distribution, a ball-shaped spacer is distributed on a substrate by dry or wet method during a panel process. But while forming a cylinder-shaped spacer, the processes

such as a resist coating, exposure, development, post-bake and a general photo-lithography are increased by one time. Therefore, the cost will increase due to the material costs, the equipment investment and a process number.

Further, since a process for forming a contact hole on a flattening layer before same process, and same photo-lithography when forming a cylinder-shaped spacer are repeated, the process number increases.

Accordingly, the object of the present invention is to provide a manufacturing method of a LCD apparatus, an array substrate, and a LCD apparatus, in case that a cylinder-shaped spacer method formed by a photo-lithography method is used instead of a conventional ball-shaped spacer distribution method.

[Means for Solving the Problem]

In order to solve above-mentioned problems, a manufacturing method of a LCD apparatus set forth in the claim 1 is a method comprising a process for forming an array having a pixel electrode and a switching active element for driving said pixel electrode, a process for forming a color filter substrate having an opposing electrode of said pixel electrode, a process for forming a cylinder-shaped spacer on said array substrate, and a process for sealing liquid crystal into a gap between said color filter substrate and said array

substrate, wherein a flattening layer is formed on said switching active element of said array substrate, and said pixel electrode is formed on the flattening layer pixel, and is characterized in that said method includes a process for forming a photo-sensitive resin on said array substrate, when forming said flattening layer, and a process for exposing said photo-sensitive resin to a light, and developing by using a photo mask having a pattern for a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode, and a pattern for a panel display region except said cylinder-shaped spacer and said contact hole with each pattern having different transmissivity.

In this way, since a process for forming a photo-sensitive resin on said array substrate, when forming said flattening layer, and a process for exposing said photo-sensitive resin to a light, and developing by using a photo mask having a pattern for a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode, and a pattern for a panel display region except said cylinder-shaped spacer and said contact hole with each pattern having different transmissivity are included, said cylinder-shaped spacer and said contact hole having a predetermined height are formed on an array substrate at the same time by only one exposure and development.

A manufacturing method of a liquid crystal display apparatus set forth in the claim 2 is a method comprising a process for forming a color filter on-array substrate having a pixel electrode and a switching active element for driving said pixel electrode, a process for forming an opposing substrate having an opposing electrode of said pixel electrode, a process for forming a cylinder-shaped spacer on said color filter on-array substrate, and a process for sealing liquid crystal into a gap between said color filter on-array substrate and said opposing substrate, wherein a flattening layer including a coloring layer is formed on said switching active element of said color filter on-array substrate, and said pixel electrode is formed on the flattening layer pixel, and is characterized in that said method includes a process for forming a photo-sensitive resin on said array substrate, when forming said flattening layer, and a process for exposing said photo-sensitive resin to a light, and developing by using a photo mask having a pattern for a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode, and a pattern for a panel display region except said cylinder-shaped spacer and said contact hole with each pattern having different transmissivity. In this way, since a process for forming a photo-sensitive resin on said array substrate, when forming said flattening layer, and a process for exposing said photo-sensitive resin to a light, and

developing by using a photo mask having a pattern for a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode, and a pattern for a panel display region except said cylinder-shaped spacer and said contact hole with each pattern having different transmissivity are included, said cylinder-shaped spacer and said contact hole having a predetermined height are formed on an array substrate at the same time by only one exposure and development.

An array substrate set forth in the claim 3 is characterized in that it includes a color filter on-array substrate having a pixel electrode and a switching active element for driving said pixel electrode, a flattening layer is formed on said switching active element, said pixel electrode is formed on a surface of said flattening layer, and a cylinder-shaped spacer for forming a cell gap is formed integrally with said flattening layer.

In this way, since a flattening layer is formed on said switching active element, said pixel electrode is formed on a surface of said flattening layer, and a cylinder-shaped spacer for forming a cell gap is formed integrally with said flattening layer, it is possible to form a contact hole, and a cylinder-shaped spacer through same processes by exposing said photo-sensitive resin which is a flattening layer, to a light, and developing by using a photo

mask having a pattern for a contact hole, a pattern for said cylinder-shaped spacer, and a pattern for a panel display region except said cylinder-shaped spacer and said contact hole.

An array substrate set forth in the claim 4 is characterized in that it includes a pixel electrode and a switching active element for driving said pixel electrode, a flattening layer having a coloring layer is formed on said switching active element, a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode electrically is formed on said flattening layer, and a cylinder-shaped spacer for forming a cell gap is formed integrally with said flattening layer.

In this way, since a flattening layer having a coloring layer is formed on said switching active element, a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode electrically is formed on said flattening layer, and a cylinder-shaped spacer for forming a cell gap is formed integrally with said flattening layer, it is possible to form a contact hole, and a cylinder-shaped spacer through same processes by exposing said photo-sensitive resin which is a flattening layer, to a light, and developing by using a photo mask having a pattern for a contact hole, a pattern for said cylinder-shaped spacer, and a pattern for a

panel display region except said cylinder-shaped spacer and said contact hole.

A LCD apparatus described in the claim 5 is composed of a color filter substrate having the array substrate set forth in the claim 3, and an opposing electrode of the pixel electrode.

In this way, since a color filter substrate having the array substrate set forth in the claim 3, and an opposing electrode of the pixel electrode are provided, it is possible to form a contact hole, and a cylinder-shaped spacer through the processes which are same to the processes described in the claim 3.

A LCD apparatus described in the claim 6 is composed of an array substrate set forth in the claim 4, and an opposing substrate having an opposing electrode of the pixel electrode.

In this way, since an array substrate set forth in the claim 4, and an opposing substrate having an opposing electrode of the pixel electrode are provided, it is possible to form a contact hole, and a cylinder-shaped spacer through the processes which are same to the processes described in the claim 4.

[Embodiment of the Invention]

The first embodiment of the present invention will be explained with referring to FIG. 1 and FIG. 2.

FIG. 1 is a cross-section showing processes for forming a cylinder-shaped spacer used in LCD apparatus of the first embodiment of the present invention, and manufacturing an array substrate on which a pixel electrode and a switching active element are conducting by a contact hole.

A manufacturing method of a liquid crystal display apparatus includes a process for forming an array having a pixel electrode and a switching active element for driving said pixel electrode, a process for forming a color filter substrate having an opposing electrode of said pixel electrode, a process for forming a cylinder-shaped spacer on said array substrate, and a process for sealing liquid crystal into a gap between said color filter substrate and said array substrate. In forming an array substrate, first of all, as is shown in FIG. 1(a), a switching active element 3 is formed on a glass substrate 2a by etching repeatedly according to a general semiconductor thin film forming method, an insulating layer forming method, and photo-lithography method.

Next, as is shown in FIG 1(b), a negative photo-sensitive resin layer 5 is formed on said substrate. At this time, a thickness of a photo-sensitive resin layer 5 is determined after designing a gap thickness of a liquid crystal

panel and a layer thickness of a flattening layer remained on the glass substrate in advance.

Then, as is shown in FIG. 1(c), a negative photo-sensitive resin layer 5 is exposed by ultraviolet rays, and by a photomask 20. The photomask 20 used at this time, makes the portion for forming a cylinder-shaped spacer 5b be an entirely transparent region 20a, makes the portion for forming a contact hole 6 be a shading region 20c, and makes the panel display region except them be a half tone region 20b. A pattern shape of such half tone region 20b, as is shown in FIG. 2(a) - (f), uses a slit or hole shape having about 0.3 - 1μm. Further, a density is determined by a desired exposure amount. Further, at this time, the exposure amount is determined by the height of a cylinder-shaped spacer 5b and sensitivity of a photo-sensitive resin layer 5.

Subsequently, through a development process, a cylinder-shaped spacer 5b having a desired height cab be formed and a contact hole 7 can be also formed.

Then, ITO is formed on a surface of FIG. 1(e) by a sputtering method, and a pixel electrode 8 is formed by a conventional photo-lithography method. Further, a layer thickness of ITO is set to 500×10-10m - 1500×10-10m. Through this process, a switching active element 3 is conducting electrically

to the pixel electrode 8.

According to those processes, a cylinder-shaped spacer 5b and a flattening layer 5a are formed at the same time, and a cylinder-shaped spacer can be formed without increasing the process number.

Below, an array substrate and a LCD apparatus according to the first embodiment of the present invention will be explained with referring to FIG. 3. FIG. 3 is a cross-section of a LCD apparatus according to the first embodiment of the present invention.

A substrate 11a of FIG. 3 is an array substrate on which a cylinder-shaped spacer is formed according to above-mentioned processes, and is composed of a pixel electrode 8, and a switching active element 3 for driving said pixel electrode. Further, the color filter substrate 1a is composed of a shading layer 4 formed on the glass substrate 2a, a color filter including a RGB coloring layer 6R, 6G, 6B, and a transparent electrode 10 on it.

Further, a flattening layer 5a is formed on a switching active element 3 of an array substrate 11a, a pixel electrode 8 is formed on a surface of said flattening layer 5a, a contact hole 7 for conducting said switching active element, said pixel electrode electrically is formed on the flattening layer 5a, and a cylinder-shaped spacer is formed integrally with said flattening layer.

Next, the orientation layers 9a, 9b are formed on the opposing surfaces of a substrate 1a, and an array substrate 11d, respectively. And liquid crystal 14 is filled into a gap into which a cylinder-shaped spacer 5b of the substrates 1a, 11a, is arranged, and a periphery is adhered with a seal member 13. According to the purpose of an liquid crystal panel 31a, a polarized plate can be bonded on an inner surface of the panel.

The second embodiment of the present invention will be explained with referring to FIG. 4 and FIG. 5.

FIG. 4 is a cross-section showing processes for forming a cylinder-shaped spacer used in LCD apparatus of the second embodiment of the present invention, and manufacturing a color filter on-array substrate on which a pixel electrode and a switching active element are conducting by a contact hole.

A manufacturing method of a liquid crystal display apparatus includes a process for forming a color filter on-array substrate having a pixel electrode and a switching active element for driving said pixel electrode, a process for forming an opposing substrate having an opposing electrode of said pixel electrode, a process for forming a cylinder-shaped spacer on said color filter on-array substrate, and a process for sealing liquid crystal into a gap

between said color filter on-array substrate and said opposing substrate. In forming an array substrate on which a color filter is formed, first of all, as is shown in FIG. 4(a), a switching active element 3 is formed on a glass substrate 2a by etching repeatedly according to a general semiconductor thin film forming method, an insulating layer forming method, and photo-lithography method. Then, a coloring layer 5 is formed on the switching active element 3, and a contact hole is formed on the coloring layer 5.

Next, as is shown in FIG 4(b), a negative photo-sensitive resin layer 5 is formed on said substrate. At this time, a thickness of a photo-sensitive resin layer 5 is determined after designing a gap thickness of a liquid crystal panel and a layer thickness of a flattening layer remained on the glass substrate in advance.

Then, as is shown in FIG. 4(c), a negative photo-sensitive resin layer 5 is exposed by ultraviolet rays, and by a photomask 20. The photomask 20 used at this time, makes the portion for forming a cylinder-shaped spacer 5b be an entirely transparent region 20a, makes the portion for forming a contact hole 6 be a shading region 20c, and makes the panel display region except them be a half tone region 20b.

A pattern shape of such half tone region 20b, as is shown in FIG. 2(a) -

(f), uses a slit or hole shape having about 0.3 - 1μm. Further, a density is determined by a desired exposure amount. Further, at this time, the exposure amount is determined by the height of a cylinder-shaped spacer 5b and sensitivity of a photo-sensitive resin layer 5.

Subsequently, through a development process, a cylinder-shaped spacer 5b having a desired height cab be formed and a contact hole 7 can be also formed.

Then, ITO is formed on a surface of FIG. 4(e) by a sputtering method, and a pixel electrode 8 is formed by a conventional photo-lithography method. Further, a layer thickness of ITO is set to 500×10-10m - 1500×10-10m. Through this process, a switching active element 3 is conducting electrically to the pixel electrode 8.

According to those processes, a cylinder-shaped spacer 5b and a flattening layer 5a are formed at the same time, and a cylinder-shaped spacer can be formed without increasing the process number.

Below, an array substrate and a LCD apparatus according to the second embodiment of the present invention will be explained with referring to FIG. 5. FIG. 5 is a cross-section of a LCD apparatus according to the second embodiment of the present invention.

A substrate 11b of FIG. 5 is a color filter on-array substrate on which a cylinder-shaped spacer 5b is formed according to above-mentioned processes, and is composed of a pixel electrode 8, and a switching active element 3 for driving said pixel electrode. Further, a color filter on-array substrate is composed of a shading layer 4 formed, and a color filter including a RGB coloring layer 6R, 6G, 6B. An opposing substrate of 1b includes a transparent electrode 10 on the glass substrate 2a.

Further, a flattening layer is formed on a switching active element 3 of a color filter on-array substrate 11b, a pixel electrode 8 is formed on a surface of said flattening layer, a contact hole 7 for conducting said switching active element, and said pixel electrode electrically is formed on the flattening layer, and a cylinder-shaped spacer is formed integrally with said flattening layer. In this case, The flattening layer is composed of a coloring layer 6 and a flattening layer 5a.

Next, the orientation layers 9a, 9b are formed on the opposing surfaces of a substrate 1b, and an array substrate 11b, respectively. And liquid crystal 14 is filled into a gap into which a cylinder-shaped spacer 5b of the substrates 1b, 11b, is arranged, and a periphery is adhered with a seal member 13. According to the purpose of an liquid crystal panel 31b, a

polarized plate can be bonded on an inner surface of the panel.

Further, it is possible to form a flattening layer by only a coloring layer 6. In addition, a photomask includes a pattern for a cylinder-shaped spacer, a pattern for a contact hole, and patterns for other panel display region. Each of them has a different transmissivity, therefore, in this case, same effects can be obtained by reversing the entirely transparent position and a shading position of a photomask.

[Effect of the Invention]

According to a manufacturing method of a LCD apparatus set forth in the claim 1, since a process for forming a photo-sensitive resin on said array substrate, when forming said flattening layer, and a process for exposing said photo-sensitive resin to a light, and developing by using a photo mask having a pattern for a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode, and a pattern for a panel display region except said cylinder-shaped spacer and said contact hole with each pattern having different transmissivity are included, said cylinder-shaped spacer and said contact hole having a predetermined height are formed on an array substrate at the same time by only one exposure and development. Therefore, the present invention can be realized

without increasing the cost through same process to a process which is applied for a substrate for adhering a conventional flattening layer.

According to a manufacturing method of a liquid crystal display apparatus set forth in the claim 2, since a process for forming a photo-sensitive resin on said array substrate, when forming said flattening layer, and a process for exposing said photo-sensitive resin to a light, and developing by using a photo mask having a pattern for a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode, and a pattern for a panel display region except said cylinder-shaped spacer and said contact hole with each pattern having different transmissivity are included, said cylinder-shaped spacer and said contact hole having a predetermined height are formed on an array substrate at the same time by only one exposure and development. Therefore, the present invention can be realized without increasing the cost through same process to a process which is applied for a substrate for adhering a conventional flattening layer.

According to an array substrate set forth in the claim 3, since a flattening layer is formed on said switching active element, said pixel electrode is formed on a surface of said flattening layer, and a cylinder-

shaped spacer for forming a cell gap is formed integrally with said flattening layer, it is possible to form a contact hole, and a cylinder-shaped spacer through same processes by exposing said photo-sensitive resin which is a flattening layer, to a light, and developing by using a photo mask having a pattern for a contact hole, a pattern for said cylinder-shaped spacer, and a pattern for a panel display region except said cylinder-shaped spacer and said contact hole.

According to an array substrate set forth in the claim 4, since a flattening layer having a coloring layer is formed on said switching active element, a contact hole for conducting said cylinder-shaped spacer, said switching active element, and said pixel electrode electrically is formed on said flattening layer, and a cylinder-shaped spacer for forming a cell gap is formed integrally with said flattening layer, it is possible to form a contact hole, and a cylinder-shaped spacer through same processes by exposing said photo-sensitive resin which is a flattening layer, to a light, and developing by using a photo mask having a pattern for a contact hole, a pattern for said cylinder-shaped spacer, and a pattern for a panel display region except said cylinder-shaped spacer and said contact hole.

According to a LCD apparatus described in the claim 5, since a color

filter substrate having the array substrate set forth in the claim 3, and an opposing electrode of the pixel electrode are provided, it is possible to form a contact hole, and a cylinder-shaped spacer through the processes which are same to the processes described in the claim 3.

According to a LCD apparatus described in the claim 6, since an array substrate set forth in the claim 4, and an opposing substrate having an opposing electrode of the pixel electrode are provided, it is possible to form a contact hole, and a cylinder-shaped spacer through the processes which are same to the processes described in the claim 4.

[Description of Drawings]

FIG. 1 is a cross-section showing each process of the manufacturing method of a LCD apparatus according to the first embodiment of the present invention.

FIG. 2 is a plane drawing showing photo-mask types used in the embodiment of the present invention.

FIG. 3 is a cross-section of a LCD apparatus according to the first embodiment of the present invention.

FIG. 4 is a cross-section showing each process of the manufacturing method of a LCD apparatus according to the second embodiment of the present invention.

FIG. 6 is a cross-section of a conventional LCD apparatus.

FIG. 7 is a cross-section of other conventional LCD apparatus.